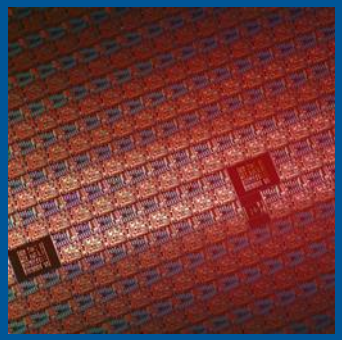
Accelerating the next technology revolution

2014 EUVL Symposium

Closing Address

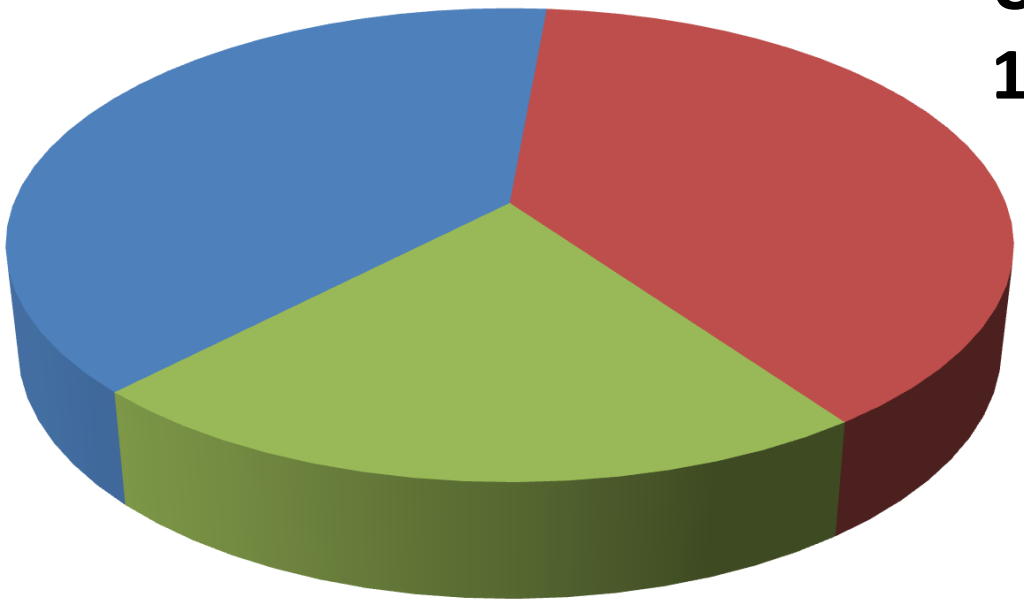
Stefan Wurm, SEMATECH
Patrick Naulleau, LBNL

October, 29 2014



EUVL Symposium Attendance in 2014: By Geographic Region

Asia / Pacific
105 (39%)

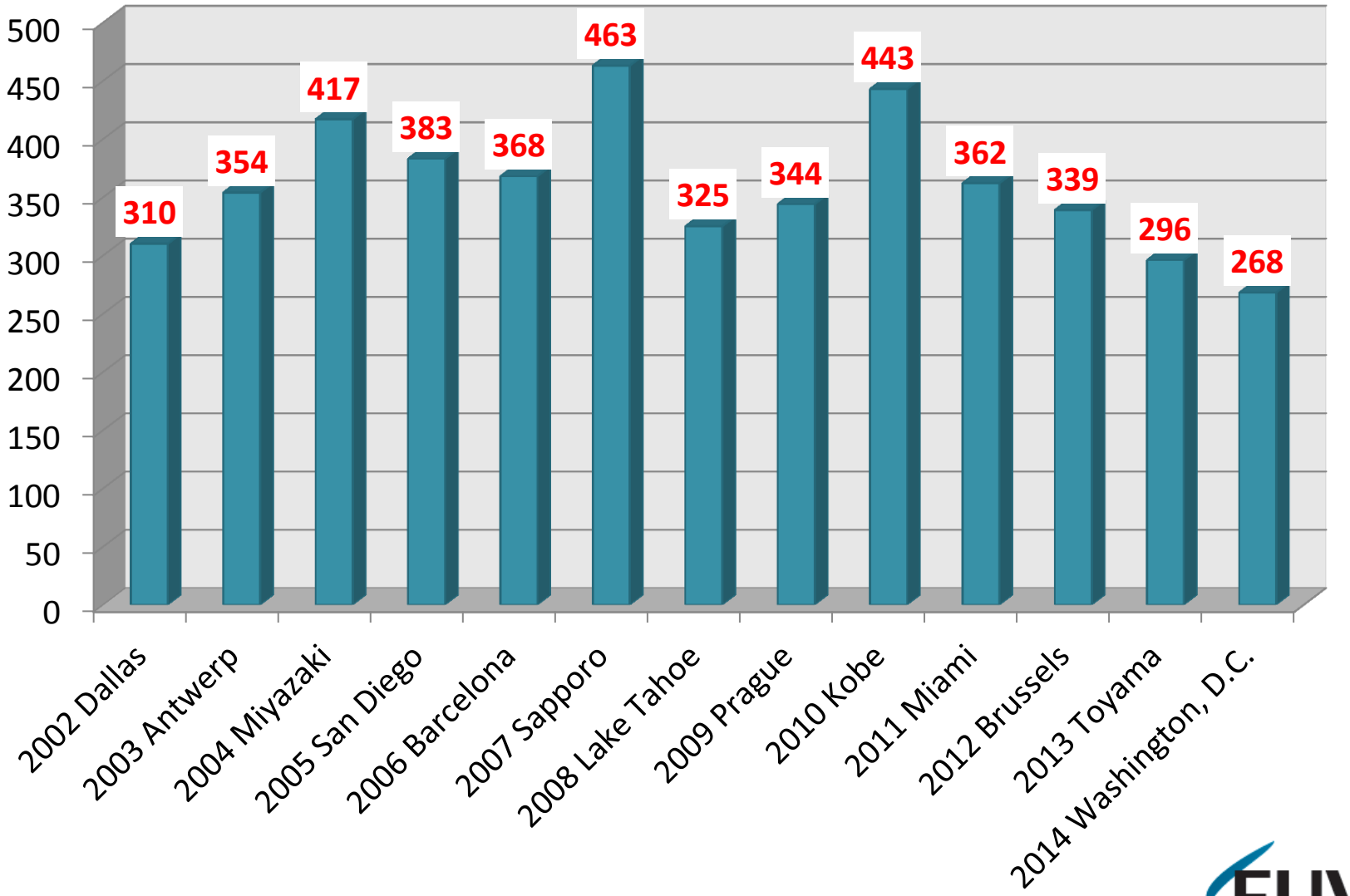


United States
104 (39%)

Europe
59 (22%)

268 Participants

EUVL Symposium Attendance by Year



Some Highlights

General Observations

- Overall, tone and outlook at the conference is positive: we are not out of the woods yet but we are on the right path (Tony Yen, TSMC)
- However, EUVL is under pressure to make significant progress over the next 12 months to become the irreversible (or reversible) 7 nm litho choice for leading edge foundry customers
- Anamorphic Lithography for high NA EUV – a major breakthrough for EUV Extendibility
  - Until recently it looked as if EUV would run out of nodes with 7 nm being seen as the last node where EUVL could be used in SP
  - The Anamorphic Lithography approach re-establishes EUVL as a multi-node technology

EUV Source

- 80W source power demonstrated in the field
  - Very encouraging that we do meet roadmap milestones as planned
  - Must meet 125W in 1H 2015
- Two customers demonstrate > 500 wafers/day on NXE3300

EUV Mask

- Actinic mask metrology tools (blank inspection and mask review) are coming online
  - Actinic patterned mask inspection remains an open challenge
- Mask blank defect reduction was demonstrated
  - Need to see this now at yield coming from commercial supply chain
  - Mask blank material supply could quickly become a bottle neck
- Pellicle membrane technology makes good progress but an industry integrated business strategy needs to be implemented

EUV Resist

- The general perception is that progress in resist materials improvement has stalled
  - There was little substantial progress over the last year
  - If not addressed, resist material readiness is at risk of quickly becoming a bottle neck for EUVL introduction
- A lot of excellent non-CAR materials research work is happening
  - This needs to quickly translate into supplier development of those new materials to drive them towards meeting manufacturing requirements

EUV Focus Areas

EUVL Focus Areas 2009-2013:

22 nm half-pitch insertion target

2009 / 22hp	2010 / 22hp	2011 / 22hp	2012 / 22hp	2013 / 22hp
1. Mask yield & defect inspection/review infrastructure	1. Mask yield & defect inspection/review infrastructure	1. Long-term reliable source operation with 200 W at IF*	1. Long-term reliable source operation with a. 200 W at IF in 2014 b. 500 W-1,000 W in 2016	1. Long-term reliable source operation with a. 125 W at IF in 2014 b. 250 W in 2015
2. Long-term reliable source operation with 200 W at IF	1. Long-term reliable source operation with 200 W at IF	2. Mask yield & defect inspection/review infrastructure	2. Mask yield & defect inspection/review infrastructure	2. Mask yield & defect inspection/review infrastructure
3. Resist resolution, sensitivity & LER met simultaneously	2. Resist resolution, sensitivity & LER met simultaneously	3. Resist resolution, sensitivity & LER met simultaneously	3. Resist resolution, sensitivity & LER met simultaneously	4. Keeping mask defect free – Availability of pellicle mtg HVM req't – Minimize defect adders during use
• EUVL manufacturing integration	• EUVL manufacturing integration	• EUVL manufacturing integration	• EUVL manufacturing integration	4. Resist resolution, sensitivity & LER met simultaneously

Ranked by 12th International EUVL Symposium Program Steering Committee. Toyama, Japan October 10, 2013

From 2013 Symposium

2014 EUVL Focus Areas

Key Focus Areas	Rank*	StdDev
Reliable source operation with > 75% availability - 125 W at IF in 1H / 2015 (at customer) - 250 W at IF in 1H / 2016 (HVM entry at customer)	1.2	0.48
Resist resolution, sensitivity & LER met simultaneously - Progress insufficient to meet 2015 introduction target	2.3	0.78
Mask yield & defect inspection/review infrastructure - Enable high yield defect free mask blank supply chain	3.1	1.08
Keeping mask defect free - Availability of pellicle meeting HVM requirement – need integrated industry strategy for solution - Minimize defect adders during use	3.3	0.89

Ranked by 13th International EUVL Symposium Program Steering Committee. Washington, D.C., October 29, 2014

**) Average of steering committee member votes*

EUVL Focus Areas 2012-2014

2012 / 22hp	2013 / 22hp	2014 / 16hp
1. Long-term reliable source operation with a. 200 W at IF in 2014 b. 500 W-1,000 W in 2016	1. Long-term reliable source operation with a. 125 W at IF in 2014 b. 250 W in 2015	1. Reliable source operation with > 75% availability – 125 W at IF in 1H / 2015 (at customer)) – 250 W at IF in 1H / 2016 (HVM entry at customer)
2. Mask yield & defect inspection/review infrastructure	2. Mask yield & defect inspection/review infrastructure	2. Resist resolution, sensitivity & LER met simultaneously – Progress insufficient to meet 2015 introduction target
3. Resist resolution, sensitivity & LER met simultaneously	4. Keeping mask defect free – Availability of pellicle mtg HVM req't – Minimize defect adders during use	3. Mask yield & defect inspection/review infrastructure – Enable high yield defect free mask blank supply chain
• EUVL manufacturing integration	4. Resist resolution, sensitivity & LER met simultaneously	3. Keeping mask defect free – Availability of pellicle mtg HVM req't : need integrated industry strategy for solution – Minimize defect adders during use

Ranked by 13th International EUVL Symposium Program Steering Committee, Washington, D.C. October 29, 2014

2015 EUVL Symposium Announcement

K. Ronse, E. Hendrickx

ANNOUNCEMENT 1

EUV SYMPOSIUM 2015

K. RONSE, E. HENDRICKX

ANNOUNCEMENT 1

29 OCTOBER 2014

FOCUS POINTS EUVS 2015

- Day 1 :

  EUV readiness :

  - Will EUVL meet the N7 insertion deadline ? (invited speakers, NXE:3300 users)

- Day 2-3 :

  EUV extendibility :

  - Progress on EUV (alternative) resist materials
  - Progress EUV alternative mask architectures
  - Progress EUV pellicles and implementation
  - Progress EUV reticle inspection
  - Progress EUV high power sources
  - Progress high NA EUV anamorphic

DATE AND ORGANIZATION

The next EUVL symposium will be held in Europe :

week of 4-7 October 2015

organized by imec, in cooperation with SEMATECH and EIDEC

Symposium Chair : Kurt Ronse

Program Chair : Eric Hendrickx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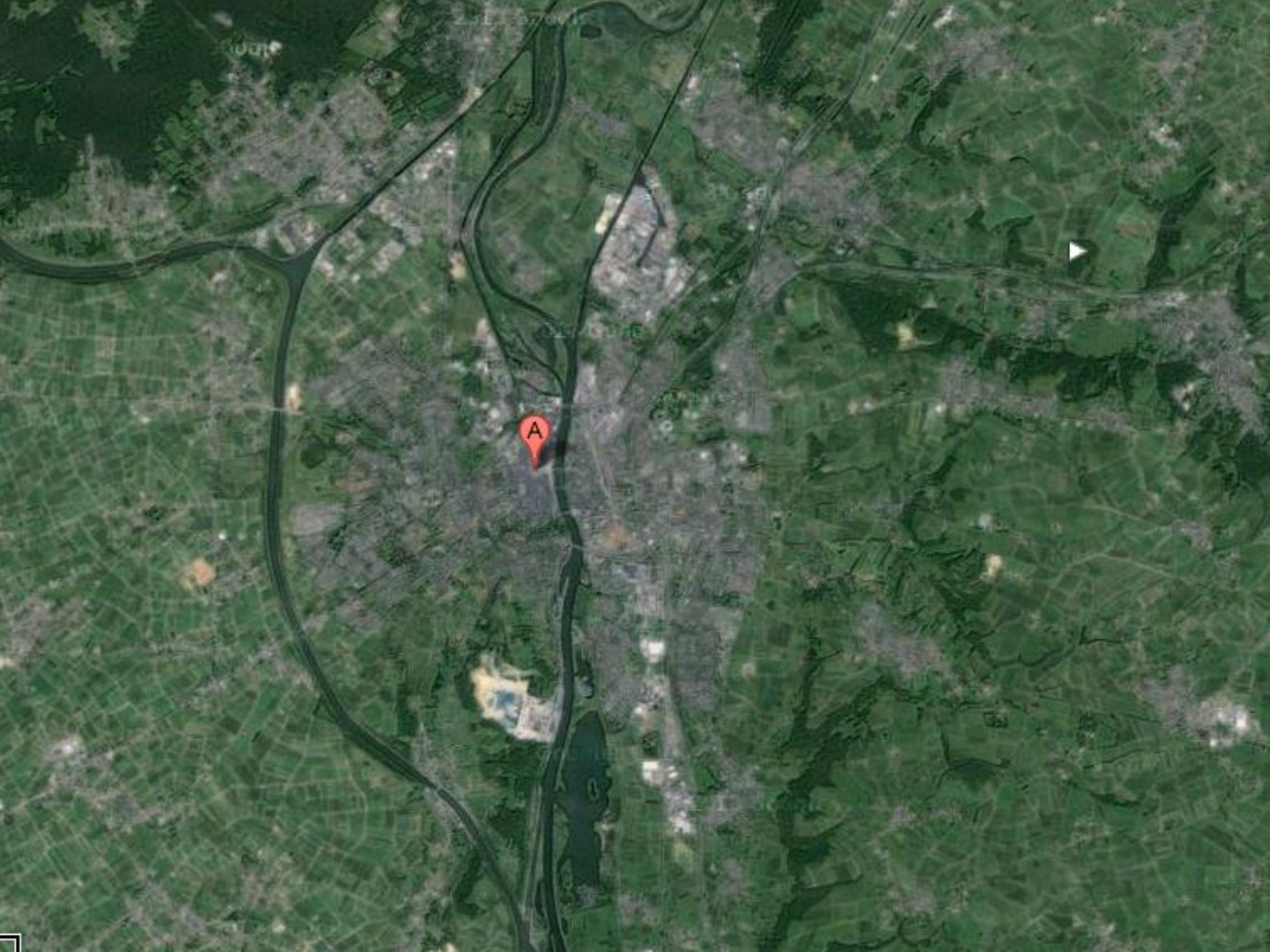
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LOCATION : MAASTRICHT (NL)

MAASTRICHT

MAASTRICHT
HOW TO REACH ?

- 2 major airports at ≈100km from Maastricht
  - Brussels International Airport (Belgium)
  - Dusseldorf International airport (Germany)

- Public transport from airport to MECC
  - Trains
  - Bus shuttle service (being considered)

CONFERENCE CENTER MECC

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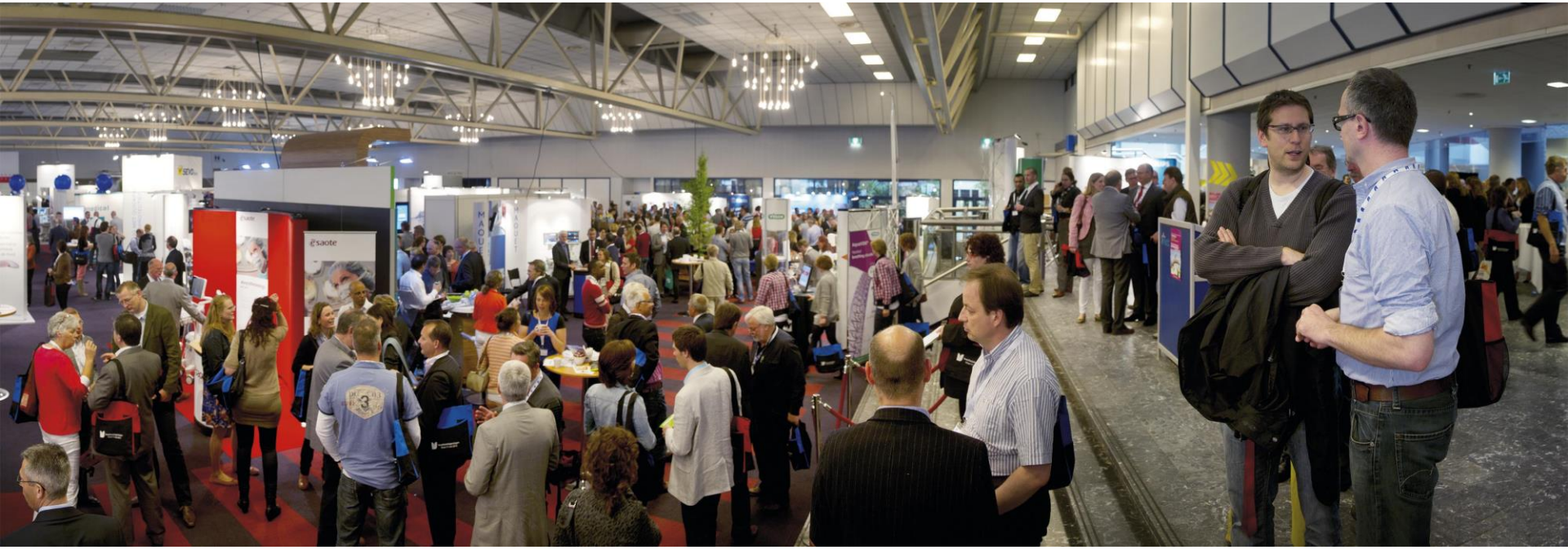

CONFERENCE CENTER MECC

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ACCOMMODATION : NH MAASTRICHT HOTEL

87,00USD/night

- Free buses connect city center with MECC
- Other hotel options in city center

MARK YOUR CALENDARS !!!

4-7 October 2015

ASPIRE
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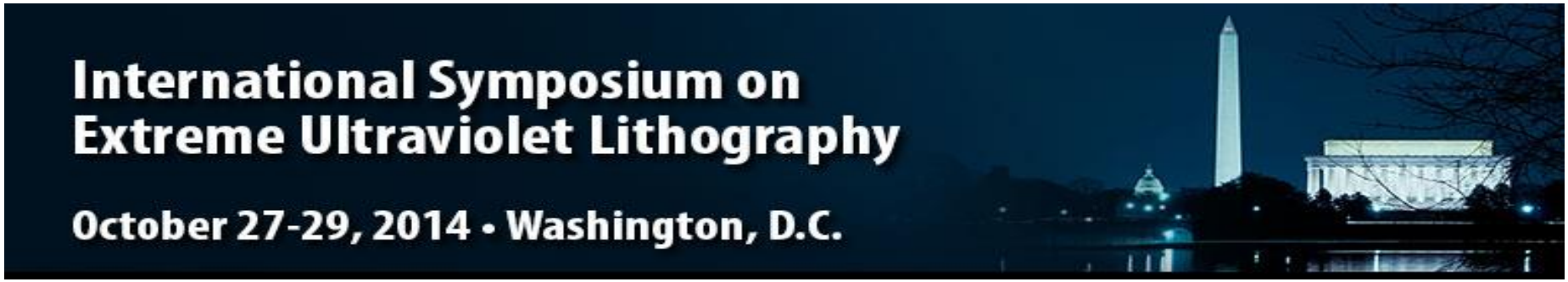
ACHIEVE

imec

Best Poster / Best Presentation



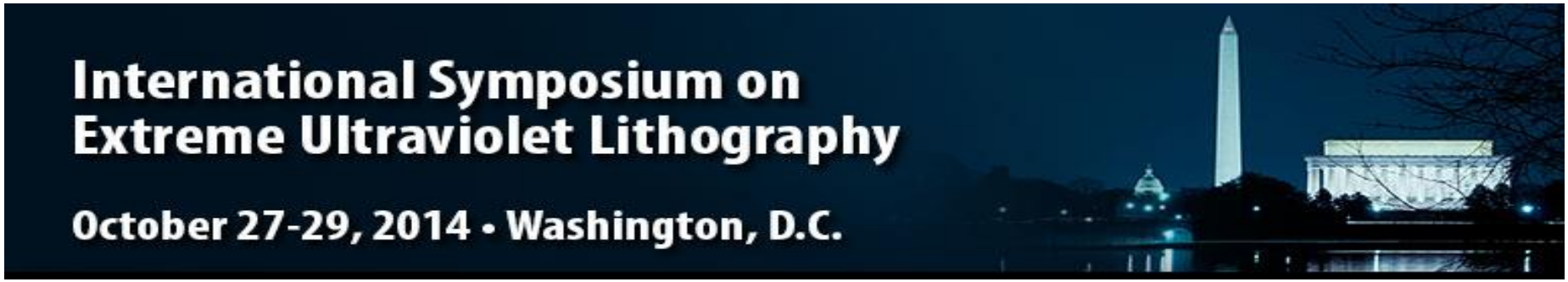
2014 EUVL Symposium Best Poster Presentation

Excellence Award

Presented to

Antoine Wojdyla
Berkeley Lab

Fourier Ptychography Microscopy with SHARP EUV Microscope for Increased Imaging Resolution Based on Illumination Diversity



2014 EUVL Symposium Best Paper Presentation

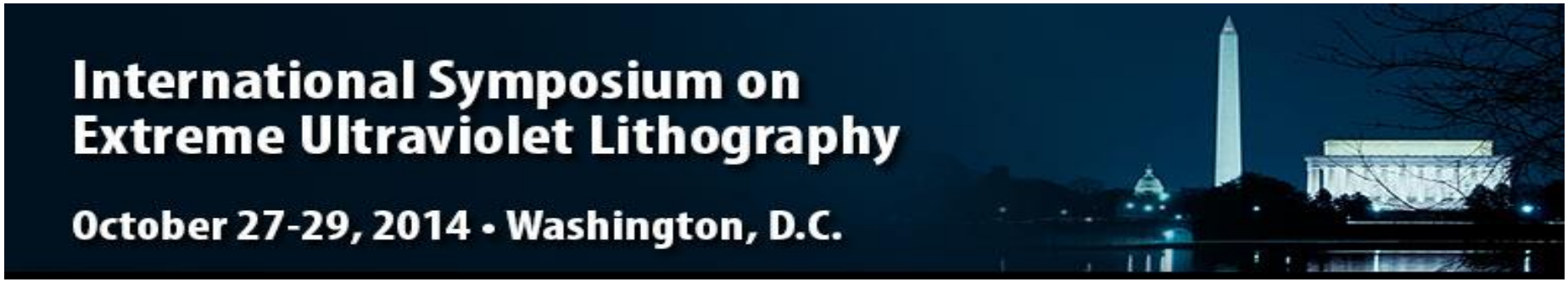
Excellence Award

Presented to

Sascha Migura
Carl Zeiss SMT GmbH

EUV Lithography Optics for sub 9nm Resolution

Thank you & Symposium Dinner



2014 EUVL Symposium Sponsors – Thank You!

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tok

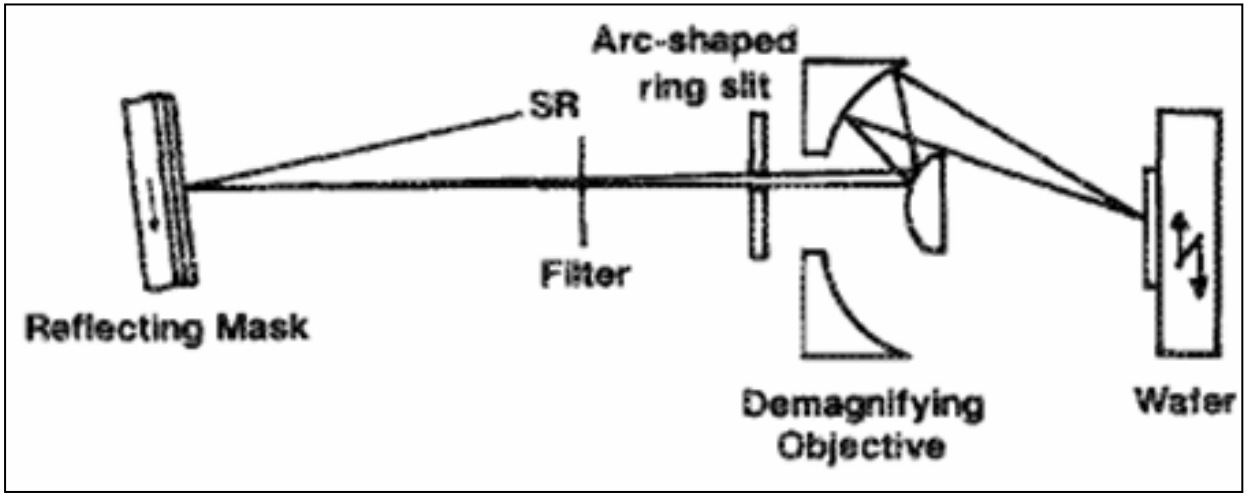
ZEISS

Thank you!

- Symposium co-chairs:
  Toshiro Itani (EIDEC), Kurt Ronse (imec)
- Program co-committee:
  Patrick Naulleau
  Soichi Inoue (EIDEC), Winfried Kaiser (Carl Zeiss)
  All abstrract reviewers
- Program logistics / support
  Marcy DeBiccary, Kelly Abbruzzese
  Our session chairs
- All paper / poster presenters
  With special thanks to our keynote and invited speakers

Thank you to an EUVL Pioneer!

Prof. Dr. Hiroo Kinoshita



Symposium Dinner

- Buses will leave at 6:30 PM
- Parkview Entrance of hotel
  - Lobby level, East Side
- Please have your name badge (if possible) to check-in prior to boarding the bus